

Differentiated Instruction

This section contains specific suggestions of ways to present the *Connected Mathematics* curriculum to English language learners, to special needs students, and to gifted students.

In addition to the material presented here, please see the separate publication *Connected Mathematics 2 Special Needs Handbook for Teachers*, which contains many samples of ways to adapt CMP materials for special needs students.

Mathematics and English Language Learners

English language learners (ELL) come into our classrooms from a variety of countries with a diverse set of experiences. They face the daunting tasks of adjusting to a new home and cultural environment, learning a new language, making new friends, and making sense of the rules, appropriate behaviors, and mechanics of a new school. Simultaneously, ELL students are experiencing many losses and trying to “fit in” with their new surroundings.

For teachers, working successfully with ELL students requires more than just teaching the content of courses. For language learners to achieve academic success, we must also support language goals and general learning strategies in the mathematics classroom (Richard-Amato & Snow, 2005). In addition, it is critical to create a friendly, supportive, and predictable classroom community. Some general suggestions are:

- Learn about your students’ home countries, languages, and previous educational experiences.
- Value students’ differences as resources.
- Stay connected to families.
- Clearly communicate school and classroom norms and expectations and be willing to check your assumptions at the door.

Teaching and learning with English language learners is a “lifelong process of learning, discovering, accepting, and trying” (Carger, 1997, p.45).

Classroom Environment and Teacher Talk

English language learners are often anxious about being in a classroom when they cannot speak English. Efforts to create a friendly environment that is respectful of students’ diverse experiences and sets high expectations for learning will greatly support ELL students’ opportunities for success. Part of establishing this kind of learning environment includes modifying the ways in which you talk with students. Patterns of speech,

intonation, or pace can often interfere with students’ understanding of your expectations and therefore impact their abilities to engage in the mathematics lesson. Many of the suggestions below work for all students, including ELL students.

Classroom Community Create a classroom community that recognizes and values students’ diverse backgrounds and experiences. Every child is born into a culture that socializes them to think in specific ways about many things we take for granted as common sense. When left unexamined, some cultural beliefs and practices can interfere with students’ success in our classrooms. Find out who your students are, where they come from, and which languages they speak.

Expectations Keep expectations high and consistent. Provide effective feedback. Too often ELL students receive “feedback that relates to personality variables or the neatness of their work rather than to academic quality” (Jackson, 1993, p. 55). If we want our students to learn and improve their work and understanding, it is crucial to be specific, focus our comments on the academic components of students’ work, and clearly communicate to students how to improve the overall quality of the work they do (Jackson, 1993).

Speak Slowly Slow down the rate at which you speak and simplify the language you use. Consider your intonation; avoid using slang, idioms, extraneous words, and long, complex sentences. Repeat key points. Rephrase to promote clarity and understanding. Summarize frequently. Use clear transition markers such as first, next, and in conclusion. Ask clear, succinct, high-level questions. (Carrasquillo & Rodriguez, 2002, Jameson, 1998)

Visual Communication Pair your instructional talk with visual communication cues such as pictures, graphs, objects, and gestures (Peregoy & Boyle, 1997).

Seating Up Front Seat students toward the middle or front of the classroom, in a place where you can observe them closely and where they can observe the classroom interactions of other students (Peregoy & Boyle, 1997).

Predictable Routine Even though your content will vary, follow a predictable routine and a stable schedule. Predictability in routine creates a sense of security for students who are experiencing a lot of change in their lives (Peregoy & Boyle, 1997).

Dictionaries Have dictionaries and other learning tools available and easily accessible to students.

Teaching Students the Norms of School

Students come from a variety of places and their constructs of school and purposes for education often greatly differ. We cannot expect that any of our students will tacitly understand the ways in which we “do” school. We must be explicit about our expectations. Problems between teachers and ELL students often occur because of language differences and unidentified assumptions about the social aspects of schooling. Therefore, it is important for teachers to help students learn what is expected of them in the school building and inside your classroom.

Create and consistently reinforce classroom norms to support students’ understanding of what is expected socially and academically in the classroom.

Post homework assignments in a public place in the classrooms so students can be responsible for checking their assignments and keeping track of whether or not they submitted them.

Provide each student with a daily agenda. As a class, write the day’s objectives, activities, and the homework assignment. Students keep these agendas in their notebooks for personal reference. It is also helpful to provide space on the agenda for students to check off the homework assignment once it has been completed and turned in. (See page 123 for an example of a daily agenda link.)

Pedagogical Strategies in the Mathematics Classroom

English language learners benefit from a variety of instructional strategies that lower their anxiety and help make content more comprehensible. Mathematical objectives should be cognitively demanding and grade appropriate. Language-related adjustments and modifications should be made, including how you modify your instructional delivery, but the cognitive demand of the mathematics should not be changed. The

learning and teaching philosophy of *Connected Mathematics* support many, if not all, of the following strategies for ELL. These strategies are also just good teaching strategies to be used with all students.

Strategies Inherent in *Connected Mathematics*

Effective Questioning Use effective questioning techniques. Research highlights the fact that teachers “frequently use few higher order questions to all students, especially to those for whom they had low expectations” (Jackson, 1993, p. 55). Higher-order questions promote analytical and evaluative thinking, affirm students’ self-perceptions as learners, and support students to think of themselves as knowledge producers rather than knowledge consumers (Jackson, 1993). (See pages 6–7 for a discussion of inquiry-based instruction.)

Cooperative Groups Use cooperative group work (see pages 106–108 for a discussion of cooperative group work). Research evidence demonstrates that cooperative group work can have a “strong positive impact on language and literacy development and on achievement in content areas” (Richard-Amato & Snow, 2005, p. 190).

Active Participation Create opportunities for students to participate with you, each other, and the mathematical content. Active participation provides students with opportunities to learn both mathematics and English. Encourage your students to ask questions of each other. (See pages 73–74 for a discussion of classroom interactions during the Launch–Explore–Summarize phases of a lesson.)

Brainstorming Use class brainstorms, predictions, quick writes, and outlines as ways to access students’ prior knowledge. It is also helpful to write students’ ideas on the chalkboard so they can see them written correctly in English.

Prior Knowledge Consider the context of the problem. Context is meant to support students’ entry into a problem by connecting to their prior knowledge and preparing them for what lies ahead. If students are unfamiliar with names, places, or objects, it will be difficult for them to access the mathematics. Sometimes it is possible to change the context of a problem without affecting

the mathematics of the problem or the objectives of the lesson. Incorporate names and places from students' home countries or situate actions within cultural practices with which students are familiar. This is also a great opportunity for students to learn common English words used in daily life. Include words in the math problems that students need to know and avoid using slang, idioms, or extraneous language. (See pages 6–7 for a discussion of context in a problem-centered curriculum.)

Expression of Ideas Provide many opportunities during class for students to explain and justify their ideas.

Journals Use journals and quick writes to provide students with opportunities to write in the mathematics classroom. Use the following suggestions as meaningful writing activities:

- Restate the problem in your own words.
- Explain how you solved the problem.
- How do you know your answer is right? (Richard-Amato & Snow, 2005)
- What do you know so far about ...?

(See pages 102–103 for a discussion of student journals.)

Model Behaviors Model what you want your students to do. Students may not understand what you say, and actions will support their understanding. For example, use visual prompts such as hand movements, facial expressions, or other body movement that suggests meaning for a word or phrase.

Support Vocabulary Development

Highlight Mathematical Vocabulary Students must understand mathematical terminology and key words to gain access to any math problem. Isolate important vocabulary and phrases by circling or underlining them in the text.

Bilingual Vocabulary Chart Create and maintain a Word Cluster or Vocabulary Chart in the classroom and in students' notebooks where new terms and their definitions are written in both English and the student's first language. Pictures are also useful additions. (See page 121 for examples of graphic organizers and 104–105 for a discussion of the development of vocabulary in *Connected Mathematics*.)

Practice Out Loud Practice speaking hard-to-pronounce words verbally as a class. It is beneficial for students to practice reading and pronouncing words correctly.

(See page 122 for five guidelines for simplifying language.)

Graphic Organizers

Use graphic organizers to scaffold your learning activities and provide ELL students access to the mathematical content. (See page 121 for examples of graphic organizers.) Graphic organizers include:

- Venn diagrams
- concept webs
- timelines
- lists
- outlines
- tree diagrams
- charts

Reading, Writing, and Waiting

Time to Prepare Give students time to read silently before asking them to discuss their ideas with a small or large group. It is also recommended to provide time for students to write their ideas on paper before they share them publicly. This will give students time to sort through their ideas before they are asked to perform in front of teachers and peers.

Write and Speak Directions Post task directions on the overhead or chalkboard while you simultaneously read the directions and have students follow along. This affords ELL students the opportunity to read the English text silently while they hear it spoken correctly.

Write in English Encourage ELL students to write in English even if the spelling and grammar is incorrect. It is also helpful for students to use a combination of English and their first language when they write in their notebooks.

Give them Time Use extra wait time so ELL students will have an opportunity to hear the question, translate the work, understand its content, formulate a response, and then speak.

Assessment of English Language Learners

Students' lack of English proficiency will affect test performance when tests are given only in English. It is also necessary to consider how students' cultural backgrounds and previous experiences might affect their ability or willingness to participate in an assessment activity. "Because schooling practices tend to conform more or less to middle-class European-American experiences and values, students from other cultural backgrounds may be misassessed by virtue of cultural and other experiential differences." (Peregoy & Boyle, 1997, page 93) Therefore, your assessment practices should allow students to show what they know in a variety of ways.

Diversity When creating assessments, consider the diversity of students' cultural, linguistic and special needs (Peregoy & Boyle, 1997).

Variety Use a variety of assessments in a variety of formats including small-group work, individual activities, drawing pictures, creating posters, engaging in interviews, constructing portfolios, journal writing, projects, and self-assessment. (See pages 77–80 for a discussion of assessment in *Connected Mathematics*.)

Rubrics Be clear and consistent with your grading system and standards. Rubrics are an excellent tool for itemizing the criteria on which students will be assessed and helping students understand what you are looking for (Richard-Amato & Snow, 2005).

Working Together Peer editing is an opportunity for students to read, edit, and comment on each other's work while gaining reading and writing experience.

Time Allow sufficient time for all students to complete the assessment.

Fewer Exercises Consider the number of exercises you assign students for homework. It will take ELL students much longer to read and make sense of the exercises than native-English speakers. Often ELL students get so bogged down in the reading comprehension that they never get to the mathematics. It will be much more meaningful and productive for both you and the students if you assign 5 or 6 well-designed exercises (and they'll be more motivated to try them), rather than a page or two of 10 to 20 exercises.

Rebus Techniques

The following suggestions follow guidelines known as rebus techniques for English language learners. *Rebus* is a general term referring to the use of pictures or other visual images to represent words or symbols. Some of these techniques are similar to those in the preceding sections.

Original Rebus Technique

On a sheet of paper, students copy the text from all or part of a page before it is discussed. During discussion, students then generate their own rebuses for words they did not understand as the words are made comprehensible through pictures, objects, or demonstrations.

This strategy ensures that English learners benefit from written communications in the same way as their English-proficient peers. While written text summarizes key concepts, includes background information, and provides directions for completing tasks, English learners often do not benefit from such communication.

In the past, English learners have been traditionally paired with English-proficient students who are asked to read aloud written text. However, this approach does not provide English learners with access to written communication. For example, English learners are asked to rely on memory when trying to recall the written information—something not required of their peers. Furthermore, simply reading information aloud does not ensure that the words are made comprehensible to the English learner. Therefore, the Original Rebus technique offers a strategy that makes written communication meaningful to English learners, without depending on peer cooperation or memory.

1. Teachers identify text perceived to be difficult for English learners to comprehend. Examples of such text may be questions appearing in Mathematical Reflections, Applications, and Connections sections of the program.
2. English learners receive a copy of the rewritten text when the corresponding page is introduced to the class. As the information from the student book is read aloud, teachers make key words understandable. For example, a teacher may demonstrate the word "snapshot" by showing a photo of a pet.

3. After students comprehend the word, the teacher writes it on the board so English learners can connect the written word with a specific meaning. At this time, English learners create an original rebus over that key word on their sheet of paper. This rebus will then help the English learners recall the meaning of the word when referring back to the text during independent work.

Note: It is essential that English learners draw their own rebuses. This ensures that whatever symbol they choose to draw has meaning to them. The problem with providing professional or teacher-drawn rebuses is that simple drawings, by themselves, do not often convey a universal understanding of the words. For example, many English-proficient students were not able to correctly identify a rebus when the word below was covered, yet could do so when they were able to view both the word and rebus. This suggests that the written word, not the rebus, conveyed the meaning in such situations. Moreover, if English learners are required to create their own rebuses, they then choose which words need to be coded. Depending on the level of English proficiency, the number of coded words can vary greatly among students.

Diagram Code Technique

Students use a minimal number of words, drawings, diagrams, or symbols to respond to questions requiring writing. Learning to organize and express mathematical concepts in writing is a skill students develop over time. If English learners are not given this same opportunity, they miss an important component of the math curriculum. This strategy provides alternate ways for students not yet proficient in writing English to express mathematical thinking on paper. While their responses will not be in the same format as those of their English-proficient peers, English learners still have the same challenge: they must record and communicate mathematical ideas so that someone else can understand their thinking.

1. At the beginning of the program, teachers model and encourage English learners to use this approach when writing answers to questions presented in the program.
2. To introduce this approach, the teacher writes several questions requiring written responses

on the board. These questions should be simple with obvious answers.

3. The teacher then shows the English learners how to answer each question without writing complete sentences and paragraphs. At the end of this session, the teacher should have modeled answering questions by using and/or combining minimal words, drawings, diagrams, or symbols.

Note: This approach can be used for any written response in the program, but it is especially useful for responding to questions found in Mathematical Reflections. Since this part of the program provides a vehicle for assessing how well students have understood key concepts of the unit, this approach enables teachers to evaluate their English learners' progress as well.

Chart Summary Technique

This technique involves presenting information by condensing it into a pictorial chart with minimal words. This extension of the Diagram Code technique offers English learners another way to organize and express mathematical thinking with a minimal amount of writing.

1. At the beginning of the program, the teacher shows various charts on any subject. The charts need to be simple, include pictures, and have a minimal number of words.
2. The teacher then creates and writes a question on the board that relates to each chart. For example, the teacher might show a chart of the life cycle of a plant divided into four sections. For this chart, the teacher could ask this question: What are the growth stages of a plant?
3. The teacher continues by showing how the chart answers this question by pointing to the drawings in each section, showing the seeds, roots, stem, and flower. The teacher also points out how each section has been labeled.
4. At the end of this session, English learners should be able to respond to a question by creating a chart with pictures and minimal words.

Note: This approach may be an alternative for English learners when responding to some of the Unit Projects requiring detailed writing.

Rebus Scenario Technique

Teachers make use of rebuses on the chalkboard during discussions and when presenting information. While modifications for primary mathematical concepts may be perceived as necessary for English learners, there may be a tendency to omit such techniques for “enrichment” information, such as text appearing under “Did You Know?” However, if programs offer English-proficient students such information, then English learners should also have an opportunity to acquire the same knowledge. Therefore, the Rebus Scenario offers teachers a simple way to ensure that all students have access to both the core and enrichment aspects of the *Connected Mathematics* program.

The teacher assesses what key words may not be understood by the English learners. As each of those words is presented, the teacher simultaneously draws a rebus on the board.

Note: If there are English-proficient “artists” in the classroom, teachers may opt to implement this approach in a slightly different way. Prior to the lesson, a teacher can ask an artistic student to come to the chalkboard to draw rebuses for targeted words. When using this approach, the teacher can then just point to the appropriate drawings during the lesson. If there is no time prior to a lesson, the artistic student can be asked to draw the rebuses as key words are presented. With this latter approach, it is important that the artist knows which words to represent as rebuses and to draw quickly.

Enactment Technique

Students act out mini-scenes and use props to make information accessible. This technique ensures that all students comprehend hypothetical scenarios presented throughout CMP. With this technique, English learners are not excluded from lessons involving situations reflective of real-life scenarios.

1. Teachers decide which simple props, if any, will enhance the enactment. These props are gathered prior to teaching the lesson.
2. At the time of the lesson, students are selected to assume the roles of characters mentioned in a CMP problem or scenario.
3. These students then pantomime and/or improvise speaking parts as they enact the written scenario presented in CMP.

Note: There may be a tendency to select only English-proficient students for mini-scene roles; however, many parts can also be given to English learners. For example, roles such as pantomiming shooting baskets or pretending to ride a bicycle can be easily enacted by English learners, as these kinds of parts do not require students to speak English.

Visual Enhancement Technique

The Visual Enhancement technique uses maps, photographs, pictures in books, and objects to make information understandable by providing nonverbal input. This technique is most helpful for conveying information that is unlikely to be understood through enactment or creating rebuses. When pictures or real objects are added to lessons, English learners have the opportunity to receive the same information presented to their English-proficient peers, who are able to understand the written text without visual aids. This approach ensures that English learners equally acquire and benefit from descriptive and/or background information sections of the program.

1. Teachers decide if information on a page is unlikely to be understood with a rebus or by having students create an enactment. For example, maps are often used with this technique to help students understand what part of the world an informative section or investigation is centered around. In contrast, a mere rebus “outline” of the same country would not be likely to be understood by anyone. Likewise, topics such as video games, different kinds of housing, and newspaper advertisements are more easily comprehended by merely showing examples than by trying to draw something representative of the topic.
2. When teachers decide visual aids are the best approach for making information accessible, examples are sought prior to teaching the lesson.
3. Teachers then show the visual aid at the appropriate time during the lesson.

Note: In the first year of implementation, English-proficient students can earn extra credit by finding appropriate visual aids for targeted lessons. Teachers can then keep the pictures, objects (if possible), and book names (with page number) on file for use in subsequent years.

Summary

The six techniques (Original Rebus, Diagram Code, Chart Summary, Rebus Scenario, Enactment, and Visual Enhancement) ensure that English learners will receive the same mathematics curriculum as their English-proficient peers. Although the techniques differ in implementation, they all offer

ways for English learners to acquire and express the mathematical ideas presented in CMP.

Although these approaches have been created specifically for English learners, they can be equally effective for many special-education students.

SUMMARY OF REBUS TECHNIQUES

Original Rebus Technique On a sheet of paper, students copy the text from all or part of a page before it is discussed. During the discussion, students generate their own rebuses for words they did not understand. This technique offers a strategy that makes written communication meaningful to students with language difficulties. First the teacher identifies text which contains important ideas and may be difficult for students with language difficulties. As this part of the text is discussed, the teacher tries to make key words understandable through pictures, objects, or demonstrations. Students create their own pictorial rebus for each of the key words.

Diagram Code Technique Students use a minimal number of words, complemented by diagrams or drawings to organize and respond to questions. The teacher should introduce and demonstrate how to express mathematical thinking without having to write in complete sentences. The ultimate goal is, of course, to have students progress towards being able to communicate mathematical thinking in writing as well as in these diagram codes.

Chart Summary Technique This is an extension of the Diagram Code. The technique involves presenting information by condensing it into a pictorial chart. As before, the teacher must model this technique so students see what is expected.

Rebus Scenario Technique To make enrichment information available to English learners, the teacher supplies quickly drawn rebuses on the chalkboard for key words in material like a “Did You Know?” passage. An artistic student may also be asked to sketch key word rebuses.

Enactment Technique Students act out mini-scenes and use props to make information accessible. This technique ensures that all students comprehend hypothetical real-life scenarios presented throughout CMP.

Visual Enhancement Technique The teacher decides if information in the text is unlikely to be understood with a rebus, as above, and provides visual aids to make information accessible.

Examples of Classroom Materials

Graphic Organizers

Graphic organizers can be used by the teacher to present information or by the students to organize information and to compare and contrast concepts and ideas. Graphic organizers such as word clusters, rebuses, and vocabulary charts can be used to support vocabulary development. Venn diagrams, concept maps, and other techniques can help students organize information.

Word Clusters Write mathematical terms on sentence strips and group them together to show how they are connected. Hang the sentence strips from the ceiling or on a wall for quick reference.

Addition +	Divide ÷	Multiply ×
Add	Dividend	Factor
Sum	Division	Product
Addend	Quotient	Multiples
Plus		

Rebuses Create rebus pictures or symbols for words the students need help to understand.

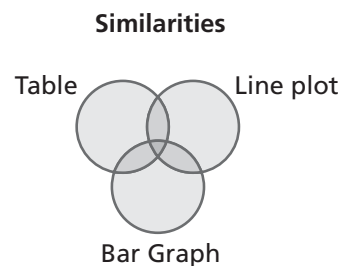
Add +	Subtract –	Triangle ▲
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- Students can draw the symbols directly over the words.
- A sheet of these symbols can be kept in the vocabulary section of students' binders.

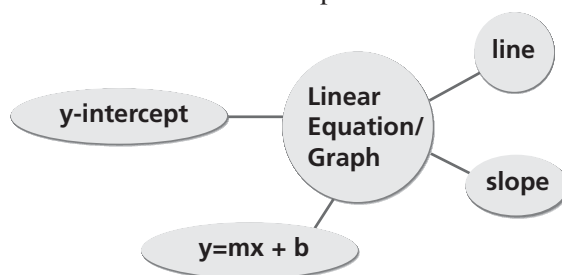
Vocabulary Charts The use of word cognates (linguistically related words) help students connect words in English to words from their own language that are familiar. Not all words have cognates. However, all terms are put on this chart even if they don't have cognates.

Term	Description	Example	Cognate
Factor	One of two or more whole numbers that are multiplied to get a product.	$2 \times 3 = 6$	Factor
Prime number	Number with only 2 factors, 1 and itself	3 1×3 1 1×7	Número Primo

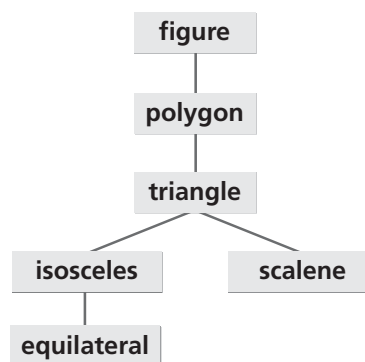
Venn Diagrams Use Venn diagrams as a way to compare and contrast information. The example below is from CMP2, *Data About Us*.



Concept Maps Concept maps are used to organize topics or categories and to visually represent connections between concepts and ideas.



Tree Diagrams/Hierarchy Use tree diagrams to organize ideas from the general to the specific and to support understanding of the relationships between concepts.



Charts, Lists, and Timelines Other ways to organize information include making charts, lists, and timelines.

Five Guidelines for Simplifying Language

Guideline	Original Text	Simplified Version												
1. Use short sentences and eliminate extraneous material.	Samuel is getting a snack for himself and his little brother, Adam. There are two candy bars in the refrigerator. Samuel takes half of one candy bar for himself and half of the other candy bar for Adam. Adam complains that Samuel got more. Samuel says this isn't true, since he got half and Adam got half. What might be the problem?	Sam and Adam have two candy bars. Sam eats half of one candy bar. Sam gives Adam half of the other candy bar. Adam is mad. He thinks Sam has more candy. What is the problem?												
2. Change pronouns to nouns.	Jorge made two graphs but he forgot to label them.	Jorge made two graphs. Jorge forgot to label the graphs.												
3. Underline key points or vocabulary.	Problem 1.1 A. How are the graphs alike? How are the graphs different? B. How can you use the graph to find the total number of letters in all of the names? C. Collect the data for your class and use graphs to represent the data distribution.	Problem 1.1 A. How are the graphs <u>alike</u> ? How are the graphs <u>different</u> ? B. How can you use the graph to find the <u>total number of letters</u> in all of the names? C. Collect the <u>data</u> for your class and use <u>graphs</u> to <u>represent</u> the data distribution.												
4. Turn narratives into lists.	Look back at the graphs that you have made in this unit. Find several graphs that show relationships in which y both increases and decreases as x increases. Describe each graph in words.	Look at the graphs you made. A. Find a graph where y increases and x increases. B. Find a graph where y decreases and x increases. C. Use words to describe each graph.												
5. Use charts and diagrams.	Maria has \$25.00 in the bank. She mows the lawn once each week and earns \$5.00 each time. Suzanna only has \$15.00 in the bank. She baby-sits her little brother for \$2.00 each weekday. Maria spends \$3.00 each week to go to the basketball game with her friends. Suzanna spends \$4.00 each week to go to the movies.	<table><tr><th></th><th>Bank</th><th>Earns</th><th>Spends</th></tr><tr><td>Maria</td><td>\$25.00</td><td>\$5.00/wk</td><td>\$3.00/wk</td></tr><tr><td>Suzanna</td><td>\$15.00</td><td>\$2.00/day</td><td>\$4.00/wk</td></tr></table>		Bank	Earns	Spends	Maria	\$25.00	\$5.00/wk	\$3.00/wk	Suzanna	\$15.00	\$2.00/day	\$4.00/wk
	Bank	Earns	Spends											
Maria	\$25.00	\$5.00/wk	\$3.00/wk											
Suzanna	\$15.00	\$2.00/day	\$4.00/wk											

Daily Agenda • 6th Grade

Monday	Tuesday	Wednesday	Thursday	Friday
Objective:	Objective:	Objective:	Objective:	Objective:
Activities:	Activities:	Activities:	Activities:	Activities:
Homework:	Homework:	Homework:	Homework:	Homework:
Monday	Tuesday	Wednesday	Thursday	Friday
Objective:	Objective:	Objective:	Objective:	Objective:
Activities:	Activities:	Activities:	Activities:	Activities:
Homework:	Homework:	Homework:	Homework:	Homework: